

REMARKS

Claims 1-8 are all the claims pending in the application.

As a preliminary matter, Applicant respectfully notes that the Examiner incorrectly indicated that the priority document and the Information Disclosure Statement were filed April 3, 2001. The correct date is February 9, 2001.

Also, the Examiner is requested to indicate the status of the drawings filed February 9, 2001.

Claims 1-8 are rejected under 35 U.S.C. § 102(e) as being anticipated by Feld et al. (US 6,266,357 B1, hereafter "Feld"). Applicant traverses the rejections with the following comments.

Applicant's invention relates to a laser apparatus including a semiconductor laser element, a surface-emitting semiconductor element, a second mirror, and a modulation unit. In an embodiment of the present invention, the surface-emitting semiconductor element includes an active layer and a first mirror arranged on one side of the active layer. As shown in FIGS. 1 and 2A, for example, a broad-area semiconductor laser element 31 outputs excitation laser light 36, which excites the surface-emitting semiconductor element 23.

Feld relates to a microcavity surface emitting laser. A microlaser structure 30 according to Feld is shown in FIG. 3, including upper and lower distributed Bragg reflectors 33 and 32 surrounding a half-wave cavity 34. FIG. 6 shows a plot of calculated light output versus current input for the microcavity surface-emitting laser structure of Feld.

Applicant submits that Feld fails to teach or suggest all of the limitations of claim 1. As an initial matter, the Examiner cites the same element (34) of Feld to teach at least three different elements of independent claim 1. At a minimum, the rejection is improper for this triple-counting of elements.

Moreover, Feld does not disclose the surface-emitting semiconductor element of the present invention. The Examiner asserts that the half wave optical cavity 34 is the surface-emitting semiconductor element, but the half wave optical cavity 34 is merely part of the waveguiding structure of the micro-cavity surface-emitting laser of Feld. Moreover, even if the micro-cavity surface-emitting laser were considered to be the surface-emitting semiconductor element of the present invention, Feld would still fail to disclose the surface-emitting semiconductor element. More specifically, Feld's micro-cavity surface-emitting laser fails to read on the Applicant's surface-emitting semiconductor element, at least because the micro-cavity surface-emitting laser is excited by an input current, as shown in FIG. 6 and discussed at col. 5, lines 15-30. To the contrary, the surface-emitting semiconductor element of the present invention, as claimed in claim 1, "is excited with said first laser light." A further fundamental flaw in the Examiner's rejection is that claim 1 describes an optically pumped surface-emitting laser whereas Feld is ambiguous on this feature. The discussion at col. 5, lines 15-30 of Feld would tend to suggest a form of current excitation. In any event, the ambiguity must be construed against the Examiner, and any further reference applied against the claims must be on a non-final basis. Hence, claim 1 is patentable over the reference for at least this reason.

Also, the Examiner asserts that the half wave optical cavity 34 of Feld is a semiconductor laser element which emits a first laser light 32 and a first wavelength 36, but Applicant disagrees

with the Examiner for the following reasons. First, the half wave optical cavity 34 is simply a cavity within a larger structure that makes up a waveguiding structure of a micro-cavity surface-emitting laser, rather than a semiconductor laser element. Second, it is not the cavity 34 that emits the laser light. Instead, it is the micro-cavity surface-emitting laser that emits the laser light. Third, the first distributed Bragg reflector mirror 32 is a mirror, not a laser light as asserted by the Examiner. Fourth, the contact layer 36 is not a first wavelength; it is simply a layer of GaAs. Thus, claim 1 is patentable for this additional reason.

To the extent multiple wavelengths are included in the resonating cavity of Feld, the Examiner's basis for rejection is without support. The Examiner relies on cavity 34 providing a first laser of a first wavelength and also as the surface emitting laser element emitting a second longer wavelength. The gain region 34 is tuned to 973 nm. Col. 5, line 23. The only other resonated mode is at 944 nm, which is a high order derivative of the 973 peak. Therefore, the purported "second emitted" wavelength does not meet the features of claim 1, since it is not longer the first wavelength.

Furthermore, the applied reference fails to teach or suggest the claimed modulation unit. The Examiner asserts that the microlaser structure 30 is a modulation unit, but there is no support for the Examiner's position. Clearly, the microlaser structure 30 is a not a modulation unit. Rather, the structure 30 is a waveguiding structure for a micro-cavity surface-emitting laser, as shown in FIG. 3 and discussed at col. 4, lines 45-61. This distinction between the present invention and Feld provides another reason for the patentability of claim 1.

AMENDMENT UNDER 37 C.F.R. § 1.111
U. S. Application No. 09/779,586

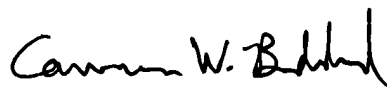
Also, claims 2-8 are allowable over the applied prior art, at least because of their dependence from claim 1.

Additionally, the specification is amended to correct spelling errors, and claims 9-13 are added to describe features of the invention more particularly. Claims 9-13 are believed to be allowable, at least because of their dependence from claim 1.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

Applicant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee, except for the Issue Fee, for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,



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APPENDIX
VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

Paragraph bridging pages 11 and 12:

Initially, an n-type GaAs buffer layer 12, an n-type GaAs/n-type $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ multilayer optical filter 13, a n-type GaAs optical confinement [later] layer 14, an undoped GaAs/ $\text{In}_{0.2}\text{Ga}_{0.8}\text{As}$ multiple-quantum-well active layer 15, a p-type GaAs optical confinement layer 16, a p-type $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ carrier confinement [later] layer 17, and a p-type GaAs cap [later] layer 18 are formed on an n-type GaAs (001) substrate 11 by organometallic vapor phase epitaxy. The lowest sublayer of the n-type GaAs/n-type $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ multilayer optical filter 13 is an AlGaAs layer. Next, a SiO_2 antireflection film 19 for laser light emitted from the surface-emitting semiconductor element is formed on the p-type GaAs cap later 18 by electron beam evaporation or the like. A ring-shaped area of the SiO_2 antireflection film 19 is removed, and then a Ti/Pt/Au p-electrode 20 is formed by evaporation using the lift-off technique on a ring-shaped area covering the above area from which the SiO_2 antireflection film 19 is removed. Thereafter, the n-type GaAs substrate 11 is polished, and regions of the n-type GaAs substrate 11 and the n-type GaAs buffer layer 12 which are broader than an oscillation region of the surface-emitting semiconductor element are removed by selective etching so that a hollow which allows passage of excitation laser light is formed. Then, a AuGe/Ni/Au n-electrode 21 is formed on the remaining area of the back surface of the n-type GaAs substrate 11, and heat treatment is performed so as to make the Ti/Pt/Au p-electrode 20 and the AuGe/Ni/Au n-electrode 21 ohmic

electrodes. Next, a SiO_2 film 22 is formed so as to cover the inner surface of the hollow, where the SiO_2 film 22 functions as an antireflection film for excitation laser light having the wavelength of 810 nm. Finally, the layered structure formed as above is cleaved, and is further formed into a chip of the surface-emitting semiconductor element 23.

Paragraph bridging pages 18 and 19:

An n-type GaAs buffer layer 52, a Bragg reflection film 53, an n-type GaAs optical confinement [later] layer 54, an undoped GaAs/ $\text{In}_{0.2}\text{Ga}_{0.8}\text{As}$ multiple-quantum-well active layer 55, an n-type GaAs optical confinement [later] layer 56, and an n-type $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ carrier confinement [later] layer 57 are formed on an n-type GaAs (001) substrate 51 by organometallic vapor phase epitaxy. The Bragg reflection film 53 is comprised of twenty pairs of n-type GaAs and n-type $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ sublayers, the n-type GaAs sublayer in each pair has a thickness of $\lambda/4n_{\text{GaAs}}$, the n-type $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ sublayer in each pair has a thickness of $\lambda/4n_{\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}}$, λ is an oscillation wavelength of the surface-emitting semiconductor element of Fig. 3, and n_{GaAs} and $n_{\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}}$ are the refractive indexes of GaAs and $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ at the oscillation wavelength λ , respectively. The lowest sublayer of the Bragg reflection film 53 is an AlGaAs layer. Thereafter, the back surface of the n-type GaAs substrate 51 is polished, and a AuGe/Ni/Au n-electrode 60 is formed on the n-type GaAs substrate 51, and heat treatment is performed so as to make the AuGe/Ni/Au n-electrode 60 an ohmic electrode. Then, a Ti/Au Schottky electrode 58 is formed by electron beam evaporation, where the Ti/Au Schottky electrode 58 has a window through which laser light exits. Then, a SiO_2 antireflection film 59 having a thickness of $\lambda/4n_{\text{SiO}_2}$ is formed over exposed area of the n-type $\text{Al}_{0.7}\text{Ga}_{0.3}\text{As}$ carrier confinement [later] layer 57, where n_{SiO_2} is the refractive index of SiO_2 at the oscillation wavelength λ . Finally, the

construction of Fig. 3 is cleaved and formed into a chip. Thus, the surface-emitting semiconductor element 61 is completed. In contrast to the first embodiment, no portion of the n type GaAs substrate 51 or the n-type GaAs buffer layer 52 is removed.

Paragraph bridging pages 23 and 24:

A GaN low-temperature buffer layer 82, an n-type GaN buffer layer 83, a Bragg reflection film 84, an n-type GaN optical confinement [later] layer 85, an $\text{In}_{x2}\text{Ga}_{1-x2}\text{N}/\text{In}_{x3}\text{Ga}_{1-x3}\text{N}$ multiple-quantum-well active layer 86 ($0 < x2 < x3 < 0.5$), an p-type GaN optical confinement [later] layer 87, an n-type $\text{Al}_{z4}\text{Ga}_{1-z4}\text{N}$ carrier confinement [later] layer 88 ($z4 > 0$), and a p-type GaN cap layer 89 are formed on a sapphire C-face substrate 81 by organometallic vapor phase epitaxy. The Bragg reflection film 84 is comprised of twenty pairs of n-type GaN and n-type AlN sublayers, the n-type GaN sublayer in each pair has a thickness of $\lambda/4n_{\text{GaN}}$, the n-type AlN sublayer in each pair has a thickness of $\lambda/4n_{\text{AlN}}$, λ is an oscillation wavelength of the surface-emitting semiconductor element of Fig. 5, and n_{GaN} and n_{AlN} are the refractive indexes of GaN and AlN at the oscillation wavelength λ , respectively. The lowest sublayer of the Bragg reflection film 84 is an AlN layer.

IN THE CLAIMS:

Claims 9-13 are added as new claims.